Heart, Lung and Circulation (2016) **25,** 184–190
1443-9506/04/$36.00
http://dx.doi.org/10.1016/j.hlc.2015.08.008

ORIGINAL ARTICLE

Modification of Simplified Pulmonary Embolism Severity Index and its Prognostic Value in Patients with Acute Pulmonary Embolism

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Received 13 May 2015; received in revised form 16 July 2015; accepted 17 August 2015; online published-ahead-of-print 16 September 2015

Background Various risk stratification systems have been used to predict the clinical outcome of patients with pulmonary embolism (PE). In this study we present a modification of the simplified Pulmonary Embolism Severity Index (S-PESI) score and evaluate its accuracy in predicting the outcome of these patients.

Materials and Methods Patients older than 18 years with documented PE were enrolled in this study. S-PESI was calculated in all patients. We added electrocardiographic evidence of right ventricular strain as a new criteria and replaced the O2 saturation of <90% in S-PESI score with PaO2 /PaCO2 ratio obtained from the arterial blood gas analysis as two newly modified criteria to define a modified form of S-PESI system (modified s-PESI). Patients were followed for about one year in outpatient clinics. Any deaths attributable to PE or for unknown reasons were considered as PE related. We defined Major Adverse Cardio-Pulmonary Events (MACPE) as sum of one-year mortality, need for thrombolysis and mechanical ventilation during index hospitalisation.

Results Among 300 enrolled patients, in-hospital mortality occurred in 38 (12.7%) and one-year mortality in 73 (24.3%) patients. Considering a cut-off point of 3, modified s-PESI score had a lower sensitivity (49.3% vs. 89%) and higher specificity (79.4% vs. 37.7%) than S-PESI to predict one-year mortality. Area Under Curve (AUC) to predict MACPE was significantly higher for modified s-PESI (0.692 vs 0.730, P=0.012).

Conclusion The modified s-PESI is superior to S-PESI in predicting one-year outcome in patients with PE and can be used for more accurate risk stratification of these patients.

Keywords Pulmonary embolism • Prognosis • Score

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Introduction

The average case fatality rate within two weeks of diagnosis of acute pulmonary embolism (PE) is about 11% [1] and it grows to more than 15% in the first three months after diagnosis, making it as deadly as acute myocardial infarction [2]. However, there is a wide spectrum of presentations for acute PE varying from a small asymptomatic one to life threatening major PE leading to haemodynamic collapse and sudden death [3]. This makes it necessary to categorise patients based on their risk profiles to decide whether to admit them to intensive care units, or to use aggressive treatments like thrombolysis or surgery or to decide on outpatient therapy. Although haemodynamic status of the patients, especially the presence of hypotension or shock, is the main determinant of the outcome [4], various electrocardiographic [5–7], echocardiographic [8,9] and CT findings [10] together with increased levels of biomarkers [11,12], indicating right ventricular overload, are said to be the determinants of the risk.

Several risk stratification systems have been developed to identify patients at high or low risk following PE. Among them the Geneva prognostic score predicts the rate of deaths, recurrent thromboembolic events, or major bleedings at three months [13]. But the need for ultrasonographic study to confirm the presence of deep vein thrombosis limits its widespread use. Another scoring system, Pulmonary Embolism Severity Index (PESI) score is based on 11 clinical parameters to predict 30-day mortality without any need for laboratory or imaging study findings [14]. Difficulties in memorising these 11 parameters with different weights limit its ease of use in busy emergency departments [15]. To overcome these limitations a Simplified PESI (S-PESI) score was suggested by Jimenes et al., including only six of the 11 original PESI variables with an equal weight [16]. It seems that the accuracy of this simplified PESI score is similar to original PESI score [15,16].

Considering the widespread availability of arterial blood gas analysis and electrocardiography systems in the emergency departments, we defined a modification of S-PESI score using both of them. Instead of O2 sat < 90% in the original S-PESI we used the PaO2/PaCO2 $\leq$ 1.8 parameter according to the study by Ozsu et al. [17] and we also added electrocardiographic (ECG) evidence of right ventricular strain or ST elevation of lead aVR to create a scoring system with seven parameters. We tried to validate S-PESI score in a cohort of our patients and to compare its accuracy with that of our modified s-PESI in predicting in-hospital outcome and one-year outcome of patients admitted with PE. We tried to assess whether these simple and widely available paraclinical tools may add to the predictive value of S-PESI or not.

Methods

Study Design

This prospective study was conducted between March 2011 and July 2013 in Madani Heart Center, Tabriz, Iran. The ethics committee of the Tabriz University of Medical Sciences reviewed and approved the study including the informed consent form for its ethical and scientific merit. After a thorough explanation of the study protocol and its non-interventional nature to the patients, an informed consent was obtained from each patient.

Study Population

Patients older than 18 years presenting with acute onset of dyspnoea, chest pain or syncope without any other identifiable cause in whom acute PE was documented were enrolled in this study. We used Siemens 64-Slice Multidetector Row CT angiography to confirm the PE except for those with a history of contrast allergy, estimated glomerular filtration rate (eGFR) < 30 ml/min or pregnancy in whom Ventilation/Perfusion lung scan was applied. Computed tomography angiography result was considered diagnostic for PE in the presence of intraluminal filling defect or arterial cut-off and high probability ventilation perfusion (V/Q) scintigraphy result was considered diagnostic. Patients admitted more than 24 hours from onset of symptoms, those with prior history of PE and those with any underlying disease limiting the estimated life expectancy to less than one month (high grade cancer or major trauma) were excluded from the study.

Management

Management of the patients was based on the attending physician's discretion. The usual treatment of PE in haemodynamically stable patients in our centre is immediate administration of unfractionated heparin (UFH) or low molecular weight heparin (LMWH) in all patients except for massive PE in which we usually prefer UFH. For those with hypotension, syncope or evidence of haemodynamic instability we use intravenous thrombolytic therapy with 1.5 million units' streptokinase in 90 mins or we advise surgical thrombectomy depending on the risk of the bleeding versus the risk of embolectomy. In those with contraindications to anticoagulant therapy or those with massive PE and pulmonary hypertension in the presence of free-floating iliofemoral or caval thrombus we deploy IVC filters. After 24-48 hours of anticoagulant therapy in stable patients we start vitamin K antagonist therapy with serial monitoring of international normalised ratio (INR) to achieve the target range of 2-3.

Scoring System

To calculate S-PESI score six variables including age > 80 years, history of cancer, chronic cardiopulmonary disease (defined as history of heart failure and/or history of chronic lung disease), pulse rate $\geq$ 110 beats/minute, systolic blood pressure < 100 mm Hg, and arterial oxygen saturation < 90% – according to original description of Jimenez et al. [16] – were defined and recorded. To assess the value of adding data from two widely available and easily interpretable tests, electrocardiogram (ECG) and arterial blood gas (ABG) analysis, we used the first recorded ECG and ABG analysis in the emergency department to calculate the PaO2 /PaCO2 ratio as discussed by Ozsu et al. [17] and to record $\geq$1 mm ST